Xact Metals Study: Southeast Chicago

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Report Authorized by: _____ _____

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Southeast Chicago, Illinois, Semi-continuous Ambient Metals Investigation

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Executive Summary and Background

The main objective of this study was to determine whether residents of the South Deering neighborhood are potentially exposed to lead (Pb) above the National Ambient Air Quality Standard (NAAQS) or toxic metals above acute and chronic health comparison levels There is a long-term Pb and toxic metals monitor operated by Illinois EPA at Washington High School in this community. The station has shown that Pb concentrations are well below the NAAQS. H istoric concentrations of manganese (Mn) have exceeded health comparison values and multiple industrial sources are potentially contributing Mn emissions.

The EPA metals trailer was deployed at Rowan Park, directly south of Washington High School , from December 12, 2014 to July 23, 2015. Pb concentrations during the study averaged 16 ng/m^3, which is well below the NAAQS. Arsenic (As) was measured with a peak 8-hour concentration of 15 ng/m^3, which is equal to California EPA's Reference Exposure Level (REL). The full-study As concentration was below the chronic health benchmark. It does not appear that As is a significant issue in this area.

Measured Mn concentrations were double thehealth comparison value previously used by EPA (108ng/m^3 as compared with the Reference Concentration of 50 ng/m^3). However Mn was below the ATSDR Minimal Risk Level of 300 ng/m^3 currently recommended by EPA. Follow-up monitoring closer to the fenceline of the main Mn-contributing facility (Kinder Morgan) may be useful to characterize the maximum exposure level in the community. There are residences and a park immediately south of Kinder Morgan that may be experiencing metals concentrations significantly higher than what was measured in this study.

Study Design

Study background and methodology are documented in the Qualit y Assurance Project Plan "Southeast Chicago, Illinois, Semi-continuous Ambient Metals Investigation" version 1.0 dated December 11, 2014. The EPA trailer was deployed on Chicago Park District property in Rowan Park. See map on Figure 1. Several metallurgic industries and bulk storage facilities are located bet ween 0.5 and 1.5 miles west, southwest, and northwest of the monitoring station.

Quality Assurance Review

Metals measurements were of sufficient quantity and quality for project objectives. Results from each individual sample hour were quality-checked according to the EPA Xact Standard Operating Procedures and study QAPP. Specific quality assurance criteria and findings are described below.

Figure 1. Southeast Chicago Study Area

1) Data completeness should be ≥75%, or 1620-2160 samples, over a 90 day period;

- The EPA metals trailer operated from December 12, 2014 through July 23, 2015. There were 15 hours of data invalidated because the sample flow rate was below acceptable limits. The metals monitor was offline briefly during routine field visits for equipment maintenance and due to occasional technical issues. No data were collected between March 20 and May 12, 2015 because of an electrical problem that was subsequently corrected. A total of 3932 valid samples were collected over a period of 223 days or 5344 possible samples. Completeness was 3932/5344 * 100% = 73.6%.

2) The lowest non-zero values reported in this study should be equal to or lower than the detection limits (DLs) specified in the instrument manual. DLs and lowest reported values are shown below on Table 1.

- Lead and toxic metals were measured well below expected DLs during this study.

Table 1. Metals DLs and lowest reported concentration of toxic metals in Chicago study, ng/m^3

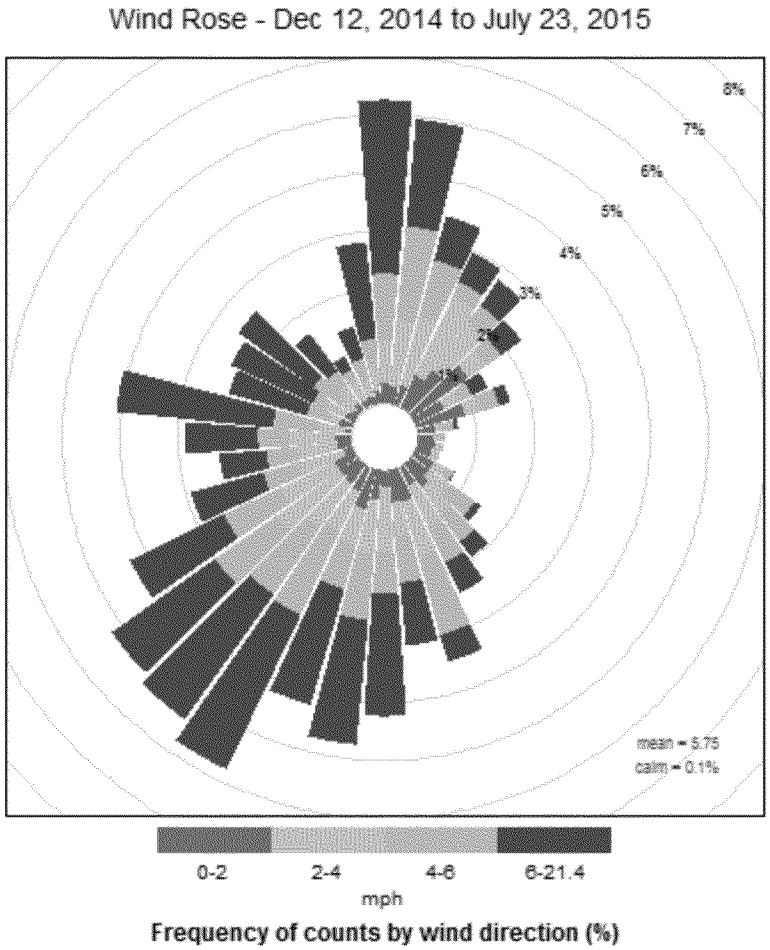
Metal	DL	Lowest Reported
Arsenic	0.051	0.001
Lead	0.099	0.547*
Manganese	0.077	0.219
Nickel	0.083	0.001
Chromium	0.092	0.003
Cadmium	1.138	0.049
Mercury	0.0912	0.001

* There were no nondetects for Pb in this study.

3) Sufficient samples should be collected when the predominant wind direction is from the target source(s).

- West, southwest, and northwest winds were the most desirable for this study because they resulted in the metals trailer being downwind of various industries along the Calumet River. A wind rose is shown on Figure 2. Winds were predominantly from the southwest, south, and north. The monitor site was directly downwind of target industries about 50% of the study period.

Figure 2. Study period wind rose



Study Findings

Concentrations for 20 metals monitored as TSP are summarized below on Table 2 . These metals had nondetect rates between zero and 79 %, which is acceptable for data analysis . Antimony, cobalt, and thallium had nondetect rates over 95% and thus were not included in the data analysis.

Table 2. SE Chicago, Illinois, metals data summary

Element, Symbol	Nondetect rate, %	Average, ng/m^3	Health Comparison Value, ng/m^3
Arsenic, As	73	0.46	2.3[b]
Barium, Ba	10	11	
Bromine, Br	0	7.0	
Cadmium, Cd	0	4.0	5.6[b]
Calcium, Ca	0	3665	
Chromium, Cr	11	8.9	42[bc]
Copper, Cu	0	19	
Iron, Fe	0	1760	
Lead, Pb	0	16	(see NAAQS)
Manganese, Mn	0	108	300[d]
Mercury, Hg	39	0.18	300[d]
Molybdenum, Mo	0	22	
Nickel, Ni	2	2.4	42[b]
Potassium, K	0	224	
Rubidium, Rb	14	0.61	
Selenium, Se	10	0.61	20,000[d]
Strontium, Sr	0	9.8	
Thorium, Th	79	0.27	
Titanium, Ti	0	48	
Zinc, Zn	0	192	
a) Averages calculated using zeroes in place of nondetects.			
b) Concentration equivalent to 10-in-1-million excess cancer risk.			
c) Assuming 2% of chromium is in most toxic hexavalent form.			
d) Reference concentration (RfC) for noncancer health effects.			

The Pb NAAQS is violated when any 3-month rolling average is higher than 150ng/m^3 meter. EPA defines the ***potential*** to exceed the NAAQS as short-term monitoring or modeling with results greater than 50% of the NAAQS (75 ng/m^3). For air toxics, monitoring data are compared against health screening values for long-term (full study average) and short -term (1-hour, 8-hour, 24-hour, and 14-day peaks) health effects, as described on the below EPA website "Dose-Response Assessment for Assessing Health Risks Associated With Exposure to Hazardous Air Pollutants ". Full-study averages and the long -term health comparison values are shown above in Table 2. There are a short-term health comparison values for only three toxic

metals: 1) Arsenic has California EPA Reference Exposure Levels (RELs) for 1-hour peaks (200 ng/m^3) and 8-hour peaks (15 ng/m^3); 2) Cadmium has an ATSDR acute Minimum Risk Level (MRL) for 1-14 days (30 ng/m^3); and 3) Nickel has an intermediate MRL for 14-365 days (200 ng/m^3).
http://www2.epa.gov/fera/dose-response-assessment-assessing-health-risks-associated-exposure-hazardous-air-pollutants

Metals risk screening results

Lead concentrations over the full study averaged 6 ng/m^3, which is notably lower than 50% of the NAAQS (75 ng/m^3). According to the data reported at IEPA's adjacent Washington High School site, the highest Pb 3-month average in 2011-13 was 50 ng/m^3. Also, the 24-hour averages of EPA's Pb monitoring were found to correlate well with IEPA's findings for samples collected between December 2014 and June 2015. For matching sample dates, the relative percent difference (RPD) was 39% with IEPA's results higher. This amount of discrepancy is to be expected for a pollutant with concentrations that are not much higher than the detection limits. In contrast, the RPD for Mn was 13% higher at the IEPA site during the study period.

Short-term and intermediate health comparison values were not exceeded for cadmium and nickel. The highest 24-hour cadmium average was 6 ng/m^3, compared with the 30 ng/m^3 MRL. The highest 14-day nickel concentration was 5 ng/m^3, compared with the 200 ng/m^3 MRL.

Arsenic (As) concentrations did not exceed the 1-hour REL (200 ng/m3), however there was a 1-hour measurement at 1 PM on January 27th of 93 ng/m^3. When averaged over 8 hours, the concentration was 15 ng/m^3, equal to the 8-hour MRL. The wind direction at this time was from the northeast. The area north and east of the monitor is not industrialized and there is no apparent explanation for the spike. Other elevated As concentrations tended to emanate from the industrial areas southwest of the monitor station.

The average manganese concentration was 108 ng/m3, which is one-third of the health comparison value currently used by EPA, the ATSDR MRL of 300 ng/m^3. The manganese average is twice as high as the EPA RfC previously used for health screening(50 ng/m^3). The measured levels are consistent with historic data reported at the Washington High School station.

Metals source contributions

The arsenic frequency distribution plot on Figure 3 shows the approximate location of the January spike northeast of the monitor station (in red), the less extreme values to the southwest (in yellow), and lowest values elsewhere (in blue). This type of plot displays the total contribution of a pollutant measured at the monitor site, distributed by wind direction and wind speed.

Arsenic concentrations on Figure 4 are displayed on a polar plot, where values are averaged by wind direction and wind speed. In contrast to the previous frequency plot, the polar plot is less influenced by short-term spikes and gives a more comprehensive view of the areas of pollutant contribution. The January arsenic spike area shows up as a faint yellow zone, whereas the more consistent area of arsenic emissions (in red) is the site of various recycling facilities southwest of the monitor.

Figure 3. Arsenic frequency plot, percent contribution binned by wind direction and speed

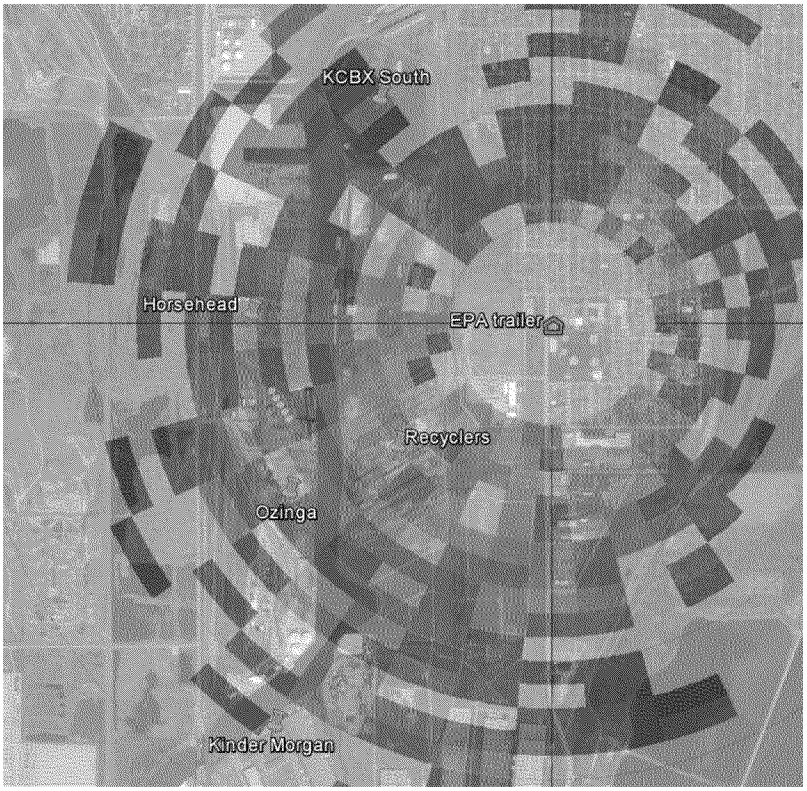
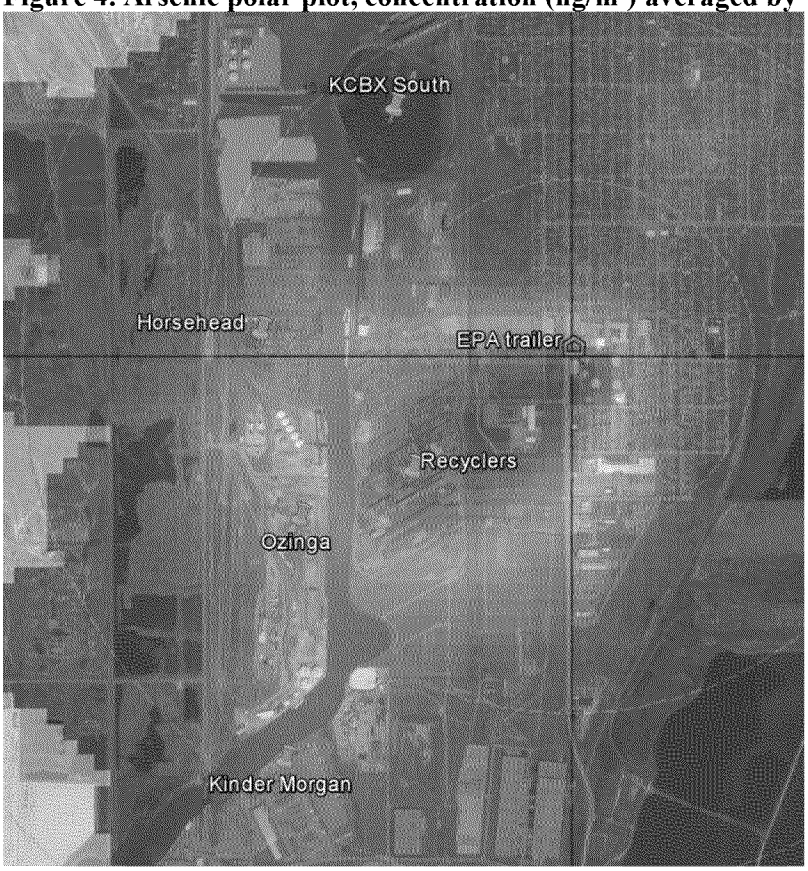


Figure 4. Arsenic polar plot, concentration (ng/m^3) averaged by wind direction and speed



The manganese (Mn) frequency distribution on Figure 5 and the polar plot on Figure 6 both point toward the southwest as the area of most significant and consistent emissions. There appear to be two distinct hot spots: one around Kinder Morgan and the second including Ozinga, the area over the Calumet River, and possibly the recycling facilities. The hour -of-day (diurnal) pattern and day -of-week patterns on Figure 7 show that Mn concentrations are highest during typical industry business hours, i.e. 8 AM to 4 PM, Monday through Friday. Mn levels drop down overnight and on the weekend.

To distinguish between temporal patterns at Kinder Morgan and Ozinga, Figure 8 contains month-to-month and day-of-week patterns only when wind direction is from these two specific source areas. The peak Mn values that emanate from Kinder Morgan are highest on Mondays and Tuesdays, with a secondary spike on Fridays. These levels were highest February to March. The peaks from Ozinga happen Tuesday-Thursday with a distinct spike in May.

Kinder Morgan, Ozinga, and the various recyclers at Reserve Marine Terminal (RMT) were all recently inspected by EPA air enforcement engineers. Kinder Morgan stores and processes ferro -alloys on site. Material unloading occurs during typical business hours, which is consistent with peak Mn values shown on Figure 7. Ozinga is also believed to handle some manganese-containing product(s) on their site, but less is known about the facility's operations schedule. Both Kinder Morgan and Ozinga may be required by the City of Chicago to develop new fugitive dust plans, which could lessen metals emissions into the community.

Figure 5. Manganese frequency plot, percent contribution binned by wind direction and speed

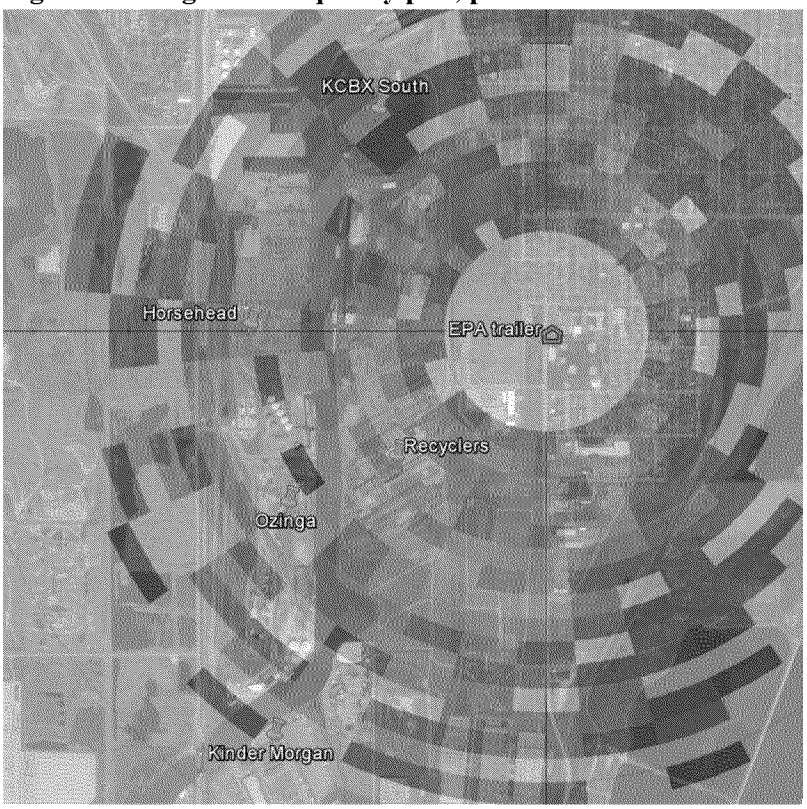


Figure 6. Manganese polar plot, concentration (ng/m^3) averaged by wind direction and speed

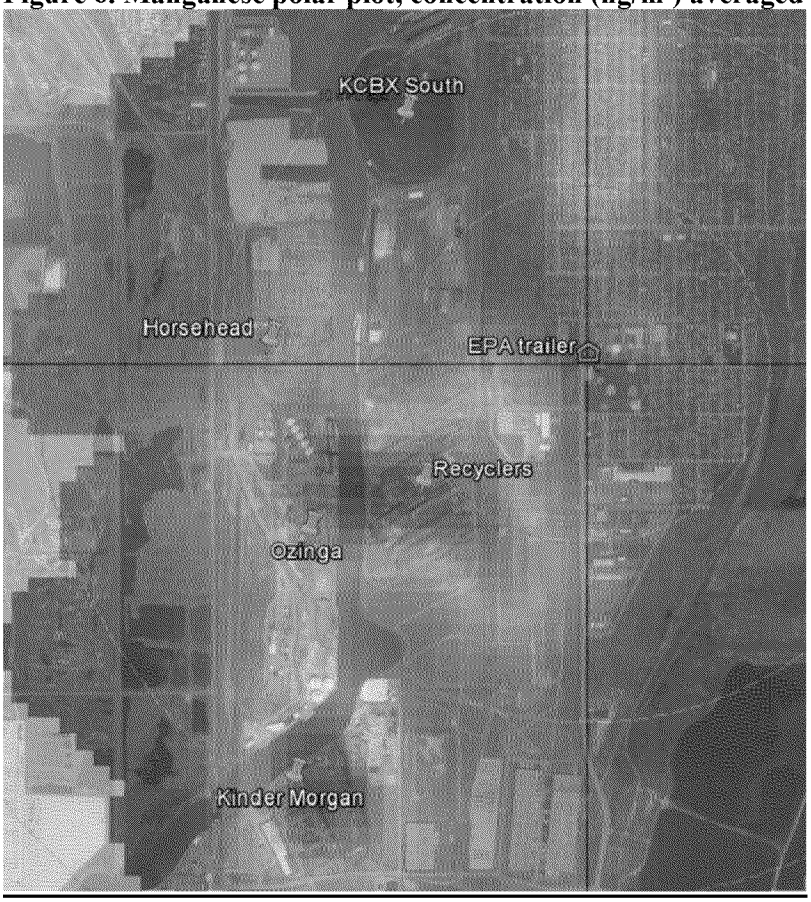


Figure 7. Manganese concentrations (ng/m^3) averaged by hour-of-day and day-of-week.

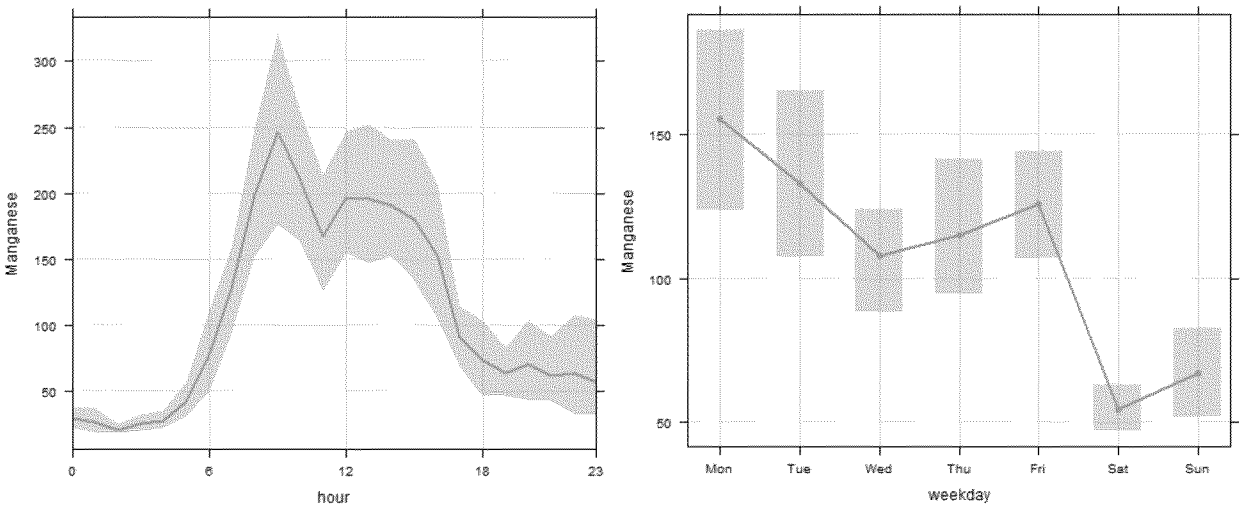
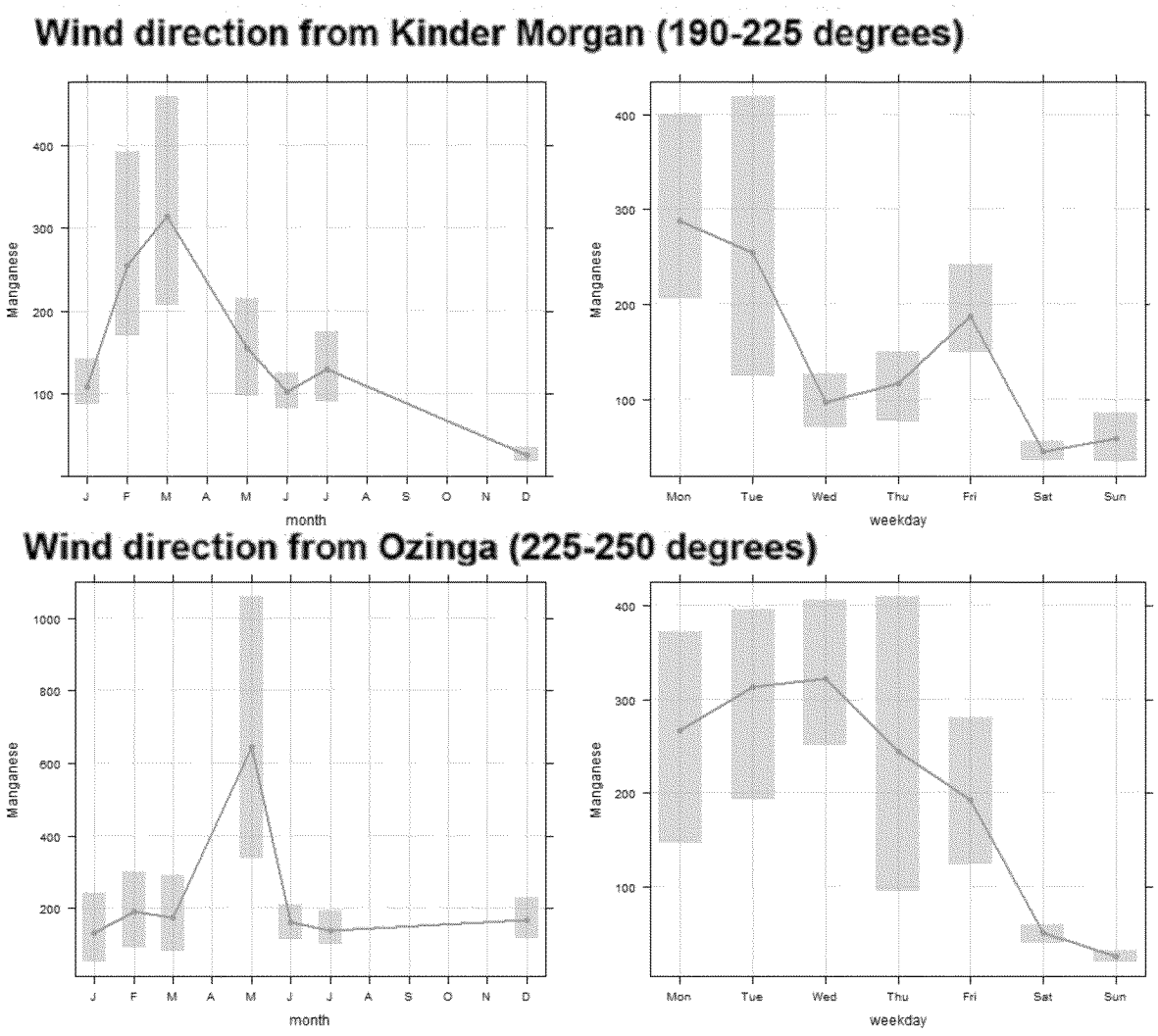


Figure 8. Manganese concentrations (ng/m^3) averaged by month and day-of-week when wind direction is from direction of Kinder Morgan as compared with Ozinga.



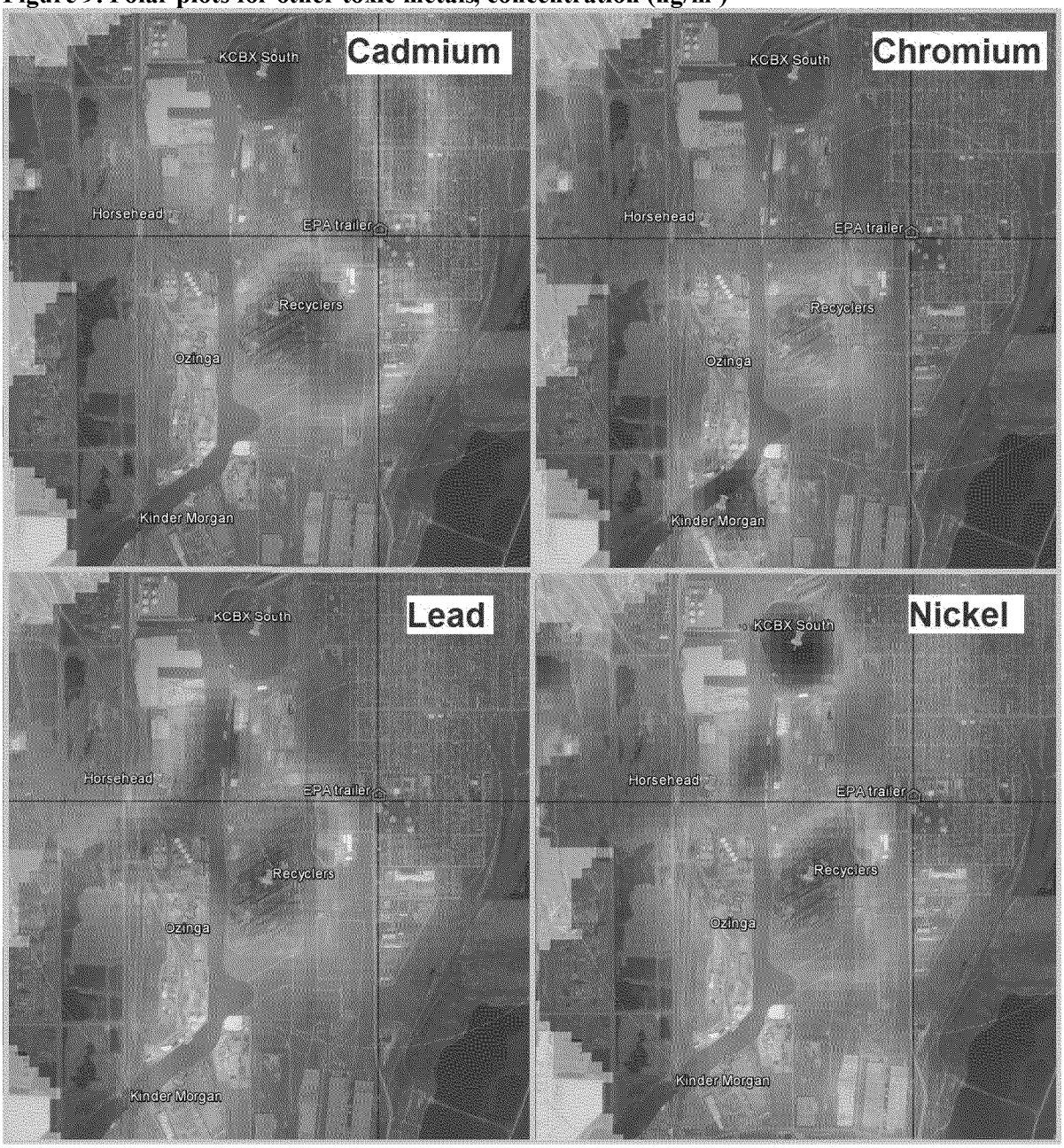
Peak manganese periods are shown on Table 3. These are the 34 hours when manganese was more than ten times the average concentration, i.e. the top 1% of data. The majority of these peak periods had winds emanating from the area of Kinder Morgan.

Table 3. Details of Peak Manganese Periods (ng/m^3)

Date	Day	Time	Mn	WD	WS
23-Dec-14	Tues	2:00 PM	1151	190	4.9
23-Dec-14	Tues	3:00 PM	1155	187	4.2
31-Dec-14	Weds	11:00 AM	1313	234	6.6
31-Dec-14	Weds	12:00 PM	1223	224	6.8
31-Dec-14	Weds	1:00 PM	2033	223	6.9
31-Dec-14	Weds	3:00 PM	1114	209	7.3
31-Dec-14	Weds	5:00 PM	1126	208	7.6
2-Jan-15	Fri	11:00 AM	1601	184	2.4
15-Jan-15	Thurs	4:00 PM	3685	199	4.8
15-Jan-15	Thurs	5:00 PM	3338	204	4.8
13-Feb-15	Fri	10:00 AM	1148	215	6.6
13-Feb-15	Fri	3:00 PM	1141	205	6.6
14-Feb-15	Sat	10:00 AM	1807	324	8.8
17-Feb-15	Tues	5:00 PM	2313	247	5.7
24-Feb-15	Tues	7:00 AM	1863	204	7.8
24-Feb-15	Tues	8:00 AM	1710	205	8.8
24-Feb-15	Tues	9:00 AM	2775	206	9.3
24-Feb-15	Tues	10:00 AM	4353	212	8.0
24-Feb-15	Tues	11:00 AM	1255	222	7.9
24-Feb-15	Tues	12:00 PM	1441	217	7.6
24-Feb-15	Tues	3:00 PM	1465	229	5.9
5-Mar-15	Thurs	6:00 PM	1373	231	4.0
5-Mar-15	Thurs	9:00 PM	2247	239	2.3
9-Mar-15	Mon	9:00 AM	2860	174	2.1
9-Mar-15	Mon	10:00 AM	2902	176	3.3
13-Mar-15	Fri	10:00 AM	1723	199	2.6
15-Mar-15	Sun	8:00 PM	1151	215	7.5
16-Mar-15	Mon	11:00 AM	1796	216	4.9
16-Mar-15	Mon	12:00 PM	2018	201	6.1
16-Mar-15	Mon	1:00 PM	3273	205	6.5
16-Mar-15	Mon	2:00 PM	3086	200	6.2
16-Mar-15	Mon	3:00 PM	1516	190	6.5
16-Mar-15	Mon	4:00 PM	1463	201	7.3
16-Mar-15	Mon	5:00 PM	2350	204	5.3

Polar plots for the remaining toxic metals, which did not exceed levels of potential health concern, are shown on Figure 9. Cadmium appears to emanate mainly from the RMT recycling facilities east of the Calumet River. Chromium peaks come from the area of Kinder Morgan. Lead seems to be emitted by a combination of the nearby recycling facilities and Horsehead. Nickel emissions emanate from KCBX's South Terminal, Horsehead, and the recycling facilities.

Figure 9. Polar plots for other toxic metals, concentration (ng/m^3)



Summary and Conclusions

1. This short-term investigation showed that Pb concentrations are well below 50% of the NAAQS.

2. Arsenic (As) was equal to theshort-term health comparison level, theCalifornia EPA's 8-hour REL (15 ng/m^3) on one day, January 27th. This high 8-hour average was driven by a 1-hour peak of 93, which itself did not cause an exceedance of the 1-hour REL (200 ng/m^3).

3. Data trends analyses show that dominant As emission are from the southwest, i.e. the area of various recyclers east of the Calumet River. However, the January 27th date peak value happened during a period when winds were from the northeast, where industrial sources are not present.

4. The full-study average for Arsenic is well below the chronic health comparison value. This study does not suggest that there is a long-term issue with As health risks.

5. Ambient concentrations of other toxic metals were below EPA's long -term and short-term health comparison levels.

6. The ambient manganese (Mn) concentration was higher than EPA's previously used comparison value (the RfC of 50 ng/m ^{3}) in this study. The Mn average was 108 ng/m^3, consistent with data reported at the Illinois EPA station at Washington High School.

7. Peak Mn levels correspond t o wind direction from the area of the Kinder Morgan facility. Secondary peaks are from the vicinity of Ozinga and RMT.

8. The monitoring trailer was sited about one mile away from the Ozinga and Kinder Morgan properties. Follow up metals monitoring may be useful in the residential area south of Kinder Morgan to determine whether Mn concentrations are significantly higher in this area.

9. Mn and other toxic metal trends at the Washington High School monitor should be evaluated over the next year to determine whether new fugitive dust controls at local industries have reduced metals emissions into ambient air.